

8. HAZARD ASSESSMENT

The objectives of this hazards assessment section are to provide guidance on the:

- Evaluation of field activities to determine the radiological, chemical, and biological exposure potential to project personnel by all routes of entry
- Evaluation of all project tasks to determine the extent that existing radiological, chemical, and physical hazards may potentially impact site personnel
- Establish the necessary monitoring and sampling required to evaluate exposure and contamination levels, determine adequate action levels to mitigate potential exposures, and provide specific actions to be followed if action levels are reached
- Engineering control determination, isolation methods for mixed waste contamination from personnel, work practices to limit personnel exposure, administrative controls, and appropriate respiratory protection and protective clothing to protect site personnel from hazards.

NOTE: *The hazards screening checklist of IWCP Standard 101, hazard Identification and Control for Operational Activity, or the Hazard Screening Profile Checklist of MCP-3562 will be used prior to the generation of the HASP to assist in hazard identification.*

The hazard classification for sampling activities is “other industrial,” and this HASP is the auditable safety plan.

8.1 Cold Test Activities

If required, a cold test (dry run) will involve simulating the activities to be performed at the site location, but in an offsite environment. The primary hazards associated with the cold test will be assessed. This area will serve to provide a “dry run” for activities to test the parameters in simulated waste material.

8.2 Site Activities

Personnel may be exposed to safety hazards, chemical, radiological, and physical agents while performing work. The magnitude of these hazards to personnel entering the work zones is dependent on both the chemical/radiological nature of the contaminants encountered and the intrusive tasks being performed. Engineering controls will be implemented (whenever practical), along with adequate work practices, real-time monitoring of contaminants, and site-specific hazard training to further mitigate potential exposures and hazards. **For site specific information regarding the Hazard Assessment for OU10-04 RI/S site activities, see Appendix C (Explosive compounds), Appendix D (OMRE), and Appendix E (Wild Onions).**

8.3 Routes of Exposure

Exposure pathways for hazardous materials and radionuclides are directly related the nature of project tasks, principally the collection of samples. Engineering controls, continuous monitoring, training, and work controls will mitigate potential contact and uptake of these hazards; however, the potential for exposure to contaminants still exists. Exposure pathways include:

- **Inhalation** of radiologically contaminated organic compounds and fugitive dusts during intrusive activities and decontamination tasks. This contamination form may have trace amounts of inorganic compounds and radionuclides resulting in potential lung deposition.
- **Skin absorption and contact** with radiologically contaminated organic and inorganic compounds during sample collection can be absorbed through unprotected skin or corrosion, resulting in chemicals burns, uptake through skin absorption, and/or skin contamination.
- **Ingestion** of radiologically contaminated organic and inorganic compounds adsorbed to dust particles or waste residues, uptake of contaminants through the GI tract that result in GI irritation, internal tissue irradiation, and/or deposition to target organs.
- **Injection**, while handling radiologically contaminated organic and inorganic materials, by breaking of the skin or migration through an existing wound, resulting in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

8.4 Environmental and Personnel Monitoring

The potential for exposure to radiological and nonradiological hazards exists during field activities for personnel who work in the CRZ and EZ. Refinement of work controls zones, engineering and administrative controls, worker training, and the use of protective equipment will mitigate most of these hazards to a large degree. In addition, direct reading instruments may be conducted to provide RADCON and IH personnel with real-time data to assess the effectiveness of these controls. **For site-specific information relating to Environmental and Personnel Monitoring, refer to Appendix C (Explosive compounds), Appendix D (OMRE), and Appendix E (Wild Onions).**

As directed by the IH and RCT, additional monitoring with direct reading instrumentation, swipes, and full and partial period air sampling may be used as deemed appropriate. Other workers and areas of the site may also be monitored to verify the integrity of core sample packages, ensure contamination has not migrated from radiologically contaminated material areas or waste containers, and to determine the effectiveness of contamination control and decontamination practices.

8.5 Physical Hazards Evaluation, Control, and Monitoring

The potential physical hazards present at the work site and the methods that will be used to monitor and control them are described in this section. Personnel need to understand the nature of the tasks, the equipment to be used, and the controls in place to eliminate or mitigate potential safety hazards.

8.5.1 Temperature Extremes

The project activities will be conducted during months where there is a potential that both heat and cold stress factors could affect task site personnel based on ambient air temperatures and layered PPE.

8.5.1.1 Heat Stress. Outside temperatures are expected to be variable during the project, and personnel will be required to wear protective clothing that prevents the body from cooling. High ambient air temperatures can result in increased body temperature, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, unconsciousness, to death. Personnel will inform the FTL or HSO when experiencing any signs and/or symptoms of heat stress, or observe a fellow employee (“buddy”) experiencing them. *LMITCO Safety and Health Manual*, MCP-2704, “Heat and Cold Stress,” and Table 8-1 of this section describe heat stress hazards further.

Table 8-1. Heat stress signs and symptoms.

Heat-Related Illness	Signs and Symptoms	Emergency Care
Heat rash	Red skin rash and reduced sweating	Keep the skin clean; change all clothing daily; cover affected areas with powder containing cornstarch or with plain cornstarch.
Heat cramps	Severe muscle cramps, exhaustion, sometimes with dizziness or periods of faintness	Move the patient to a nearby cool place; give the patient half-strength electrolytic fluids; if cramps persist, or if more serious signs develop, seek medical attention.
Heat exhaustion	Rapid, shallow breathing; weak pulse; <u>cold, clammy skin</u> ; <u>heavy perspiration</u> ; total body weakness; dizziness that sometimes leads to unconsciousness	Move the patient to a nearby cool place; keep the patient at rest; give the patient half-strength electrolytic fluids; treat for shock; seek medical attention. DO NOT TRY TO ADMINISTER FLUIDS TO AN UNCONSCIOUS PATIENT
Heat Stroke ^a	Deep, then shallow, breathing; rapid, strong pulse, then rapid, weak pulse; <u>dry, hot skin</u> ; dilated pupils; loss of consciousness (possible coma); seizures or muscular twitching	Cool the patient rapidly. Treat for shock. If cold-packs or ice bags are available, wrap them and place one bag or pack under each armpit, behind each knee, one in the groin, one on each wrist and ankle, and one on each side of the neck. Seek medical attention as rapidly as possible. Monitor the patient's vital signs constantly. DO NOT ADMINISTER FLUIDS OF ANY KIND

a. Heat exhaustion and heat stroke are serious conditions that can result in death. Transport individual immediately to the nearest medical facility. Personnel exhibiting signs and/or symptoms of heat stroke will be immediately transported to the nearest medical facility for medical attention. Section 11 details additional emergency situations and associated responses.

Monitoring for heat stress conditions shall be performed according to the LMITCO *Safety and Health Manual*, MCP-2704, "Heat and Cold Stress." Depending on the ambient weather conditions, work conditions, type of PPE worn, and the physical response of work operations personnel, the IH/RCT shall inform the FTL of necessary adjustments to the work/rest cycle. Additionally, physiological monitoring may be conducted to determine if personnel are replenishing liquids fast enough. A supply of cool drinking water will be provided in designated eating areas and consumed only in these areas. Workers may periodically be interviewed by the IH/RCT or HSO to ensure that the controls are effective and that excessive heat exposure is not occurring. Workers will be encouraged to monitor their body signs and to take breaks if symptoms of heat stress occur.

Individuals showing symptoms of heat exhaustion will: (1) stop work, (2) exit work area, (3) be decontaminated (as appropriate), (4) remove protective clothing, (5) move to sheltered area to rest, (6) be provided cool drinking water, and (7) be monitored by a Medic or CPR/First Aid certified employee.

8.5.1.2 Low Temperatures. Exposure to low temperatures could also be a factor during field activities. Relatively cool ambient temperatures and wet or windy conditions increase the potential for cold injury to personnel. The project IH or FTL will be responsible for obtaining meteorological information to determine if additional cold stress administrative controls are required. The LMITCO *Safety and Health Manual*, MCP-2704, "Heat and Cold Stress," discusses the hazards and monitoring of cold stress. Project personnel will also be cautioned regarding cold stress factors associated with rapid cooling once impermeable PPE layers are removed causing the potential for freezing of accumulated

moisture on PPE outer and inner surfaces (under extremely cold conditions). The following are provided as general measures for inner clothing layers to prevent cold stress:

- Workers should wear layered warm clothing (heavy socks, hooded garments, etc.) when the air temperature is below 40 to 45°F (4 to 7°C).

When the air temperature is below 30 to 40°F (-1 to +4°C), depending upon worker comfort, clothing for warmth, in addition to chemical protective clothing, shall be worn. This may include:

- Cold Stress
- Insulated suits, such as whole-body thermal underwear
- Wool or polypropylene socks to keep moisture off the feet if there is a potential for work activity that could cause sweating
- Insulated glove liners when air temperatures are low [<5 to 10°F (-12 to -15°C)], gloves with reflective surfaces, which reflect body heat back to the hand, should be used)
- Insulated boots, head cover such as hard hat liners

At air temperatures below 30°F (1.7°C), the following work practices should be followed:

- If the clothing of a worker might become wet on a job site, the outer layer of the clothing must be impermeable to water
- If a worker's underclothing becomes wet, the worker must change into dry clothing immediately; however, if the clothing becomes wet from sweating, the worker may finish the task that caused the sweating before changing into dry clothing
- Workers will be provided a warm area [65°F (18.3°C) or above] to change from work clothing into street clothing
- Workers will be provided a warm break area [60°F (15.6°C) or above]
- If appropriate, space heaters may be provided in work areas to warm hands, feet, etc.
- Hot liquids, such as soups or sweet drinks, shall be provided in the break area.
- The buddy system shall be practiced at all times; any personnel observed with severe shivering shall leave the cold area immediately
- Workers should layer clothing (i.e., lighter clothing layered under heavier clothing)
- To prevent heat stress, workers should dress appropriately for going into warm areas or performing strenuous activities
- Workers handling liquids that evaporate easily (gasoline, diesel fuel, etc.) shall take special precautions to avoid soaking clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling

- Work shall be planned to minimize the need for workers to sit still or stand for long periods of time.

Additional cold weather hazards exist from working on snow- or ice-covered surfaces. Slip, fall, and material handling hazards are increased under these conditions. Efforts must be made to clear walking surfaces of ice. The FTL or HSO should be notified immediately if slip or fall hazards are noted.

8.5.2 Noise

Effects from noise levels that exceed 85 decibel A-weighted (dBA) 8-hour time-weighted average (TWA) and 83 dBA for 10 hour TWA may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear, pain, and temporary or permanent hearing loss
- Interfere with communication that would warn of danger.

If necessary, noise measurements will be performed by the IH per the LMITCO *Safety and Health Manual*, MCP-2719, "Hearing Conservation Program," to determine if personnel are above allowable noise exposure levels. A TLV of 85 dBA TWA will be applied to personnel exposed to noise levels over no more than an 8-hour day. This level is based on a 16-hour "recovery" period in a low noise environment. If personnel are required to work longer than 8 hours in a hazardous noise environment, then the TLV will be adjusted to a lower value. The project IH must be consulted regarding modifications to the 85 dBA 8-hour TLV and 83 dBA for 10-hour TWA value.

Personnel whose noise exposure meets or exceeds the allowable level will be enrolled in the INEEL OMP or subcontractor Hearing Conservation Program. Personnel working on jobs that have noise exposures greater than 85 dBA (83 dBA for 10 hour TWA) will be required to wear hearing protection until noise levels have been evaluated, and will continue to wear the hearing protection specified by the IH until directed otherwise.

8.5.3 Fire, Explosion, and Reactive Materials Hazards

Fire, explosion, and reactive materials hazards at the task site could include potential explosive atmospheres, combustible materials near ignition sources (hot motor or exhaust system), transfer and storage of flammable or combustible liquids in the SZ, and chemical reaction (reduction, oxidation, exothermic, etc.) from incompatible waste materials. Portable fire extinguishers, with a minimum rating of 10A/60BC shall be strategically located at the site to combat Class ABC fires. They will be located in all active work areas, on or near site equipment that have exhaust heat sources, and all equipment capable of generating ignition or has the potential to spark. If required, a 30-pound Class D (combustible metals) portable extinguishers will be located inside the CA in the unlikely event of a combustible metal fire. All field team members will receive fire extinguisher training, as necessary, as part of this HASP training.

8.5.3.1 Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. The project Fire Protection Engineer will identify these sources as equipment is brought on the site. The accumulation of combustible materials at the site will be controlled. Disposal of combustible materials shall be assessed at the end of each shift. Class A combustibles such as, trash, cardboard, rags, wood, and plastic will be properly disposed of in metal receptacles in the SZ and in appropriate waste containers within the CRC, CRZ, and EZ.

If diesel fuel is used at the task site for generators and decontamination equipment (steam cleaner, if required for cold test), it will be safely stored, handled, and used. Only Factory Mutual/Underwriters Laboratories (FM/UL)-approved flammable liquid containers, labeled with the content, will be used to store fuel. All fuel containers will be stored at least 15 m (50 ft) from any facilities (trailers) and ignition sources, or stored inside an approved flammable storage cabinet. Additional requirements are provided in *LMITCO Safety and Health Manual*, MCP-584, "Flammable/Combustible Liquids." Portable motorized equipment such as generators, light plants, etc., will be shut off and allowed to cool down in accordance with the manufacturer's operating instructions before refueling to minimize the potential for a fuel fire. Refueling tasks will only be conducted by qualified fuel handling personnel.

8.5.4 Biological Hazards

Some of the sites are located in areas that provide habitat for various rodents, insects, and reptiles. Based on biological studies done at the INEEL, deer mice have been known to carry the Hantavirus. The virus is present in the nesting and fecal matter of deer mice. A potential exists for project personnel to disturb nesting or fecal matter during the course of mobilization and intrusive activities. If such materials are disturbed, they can become airborne and create a potential inhalation pathway for the virus. Also, contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspect rodent nesting or excrement material is encountered, the FTL and IH will be notified immediately and no attempt shall be made to remove or clean the area. Following an evaluation of the area, an SWP will be written for disinfecting and removal of it from the project task area. The IH will provide the necessary guidance for protective equipment, mixing, and application of the disinfecting solution (bleach solution), and proper disposal method of the waste. Typical PPE for disinfecting and removal of a large nesting area may include full face respirator with a HEPA filter cartridge, Tyvek coveralls, outer booties, and two pair of gloves (latex inner-nitrile outer). Generally, all seams and mating/overlapping PPE ensemble pieces will be taped.

Snakes and insects (spiders, ticks, and mosquitoes) may also be encountered at the site. Common areas to avoid include material stacking/staging areas, under existing structures (trailers, buildings, etc.), under boxes, and other areas that provide shelter for snakes. Protective clothing will prevent insects from direct contact with personnel; however, repellent (DEET or equivalent) may be required during Level D activities. Areas where standing water has accumulated provide breeding grounds for mosquitoes and should be avoided. In cases where large areas of standing water is encountered, it may be necessary to pump it dry or add a small concentration of nonhazardous surfactant to the water to break the surface tension (mosquito hatching phases). Consult with the FTL, IH, and environmental coordinator before adding surfactant to standing water areas.

8.5.5 Confined Spaces

Work in confined spaces may subject personnel to risks involving engulfment, entrapment, oxygen deficiency, and toxic or explosive atmospheres. If a suspected confined space is discovered and not properly posted, it will be treated as a permit required confined space until a determination is made by an assigned safety/IH professional. Entrances shall be posted with the required danger or caution sign per the *LMITCO Safety and Health Manual*, MCP-2749, "Confined Spaces." A confined space entry permit is required before entering a confined space per the *LMITCO Safety and Health Manual*, MCP-2749.

8.5.6 Safety Hazards

Industrial safety hazards poses a significant, if not the most likely, threat to personnel that will be encountered while performing field work. Section 6 provided general safe-work practices that must be

followed at all times. The following sections describe specific industrial safety hazards and procedures to be followed to eliminate or minimize potential hazards to project personnel.

8.5.6.1 Handling Heavy Objects. Improper lifting or handling techniques of heavy equipment may result in employee injury. If necessary, manual material handling of excessively heavy equipment will be minimized through task design and use of mechanical and/or hydraulic lifts.

8.5.6.2 Powered Equipment and Tools. As necessary, the radiological release surveys will determine what equipment can leave the CA. All power equipment and tools will be properly maintained and used according to the manufacturer's specifications by qualified individuals. The LMITCO *Safety and Health Manual*, MCP-2735, "Hand and Portable Power Tools," will be followed for all work performed with powered equipment, including powered steam cleaners.

8.5.6.3 Heavy Equipment and Moving Machinery. The hazards associated with the operation of heavy equipment include injury to personnel, equipment damage, and/or property damage. All heavy equipment will be operated in the manner in which it was attended and according to manufacturer's instructions. Only authorized personnel will be allowed in the vicinity of operating heavy equipment and should maintain visual communication with the operator. Work-site personnel shall comply with LMITCO *Safety and Health Manual*, MCP-2745, "Heavy Industrial Vehicles," MCP-2743, "Motor Vehicle Safety," and MCP-2744, "Powered Industrial Trucks."

Site personnel working around or near heavy equipment and other moving machinery shall comply with the appropriate LMITCO *Safety and Health Manual* MCPs and DOE-STD-1090-96, *Hoisting & Rigging*. Additional safe practices will include:

- All heavy equipment will have backup alarms
- Walking directly in back of or to the side of heavy equipment without the operator's knowledge will be prohibited; all precautions will have been taken before moving heavy equipment
- While operating heavy equipment in the work area, the equipment operator shall maintain communication with a designated person responsible for providing direct voice contact or approved standard hand signals; in addition, all site personnel in the immediate work area shall be made aware of the equipment operations
- All equipment shall be kept out of traffic lanes and accessways and shall be stored so as not to endanger personnel at any time.

8.5.6.4 Electrical Hazards/Energized Systems. Electrical equipment and tools, as well as underground lines, may pose shock or electrocution hazards to personnel. Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. If work on energized systems is necessary, these practices will conform with the requirements in the LMITCO *Safety and Health Manual*, MCP-2731, "Electrical Safety," LMITCO *Operations Manual*, MCP-1059, "Lockouts and Tagouts," facility supplemental MCPs, and Parts I–III of NFPA 70E. In addition, all electrical work will be reviewed and completed under the appropriate work controls (i.e., HASP, SWPs, work orders).

Before beginning any subsurface penetrations, underground utility clearances will be obtained by contacting Telecommunications (526-1688 or 526-2512). Subsurface investigation clearance will be

obtained in accordance with LMITCO *Facilities and Maintenance Manual*, MCP-151, "Subsurface Investigations." The requirements for advanced 48-hour notice shall be met.

8.5.6.5 Personal Protective Equipment. Wearing PPE will reduce a worker's ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. Also, PPE can increase the risk of heat stress. Work activities at the task site will be modified as necessary to ensure that personnel are able to work safely in the required PPE. Work-site personnel shall comply with LMITCO *Safety and Health Manual*, MCP-2716, "Personal Protective Equipment," and *Radiation Protection Manual*, MCP-432, "Radiological Personal Protective Equipment." The PPE requirements for field activities are described in Section 9 and the corresponding appendix.

8.5.6.6 Decontamination. Decontamination procedures and applicable MCPs must be followed and the appropriate level of PPE worn during DECON activities. Project RADCON and IH personnel will follow LMITCO *Radiation Protection Manual*, MCP-148, "Personnel Decontamination" and *Safety and Health Manual—14B*, MCPs and general IH practices; for sampling activities, the SAP will be followed.

8.5.7 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the task site (such as sustained strong winds 25 mph or greater), electrical storms, heavy precipitation, or extreme heat or cold) these conditions will be evaluated and a decision made by the FTL, HSO/IH, RCT, and other personnel, as appropriate, to stop work, employ compensatory measures, or to proceed. The FTL and HSO/IH shall comply with INEEL MCPs and site work control documents that specify limits for inclement weather. During all site activities, RADCON and IH personnel will determine if wind or other weather conditions pose unacceptable hazards to personnel or the environment.

8.6 Other Site Hazards

Site personnel should continually look for potential hazards and immediately inform the FTL or HSO of the hazards so that action can be taken to correct the condition.

The FTL, HSO/IH, and RCT will conduct daily inspections of the task site to ensure that barriers and signs are being maintained, unsafe conditions are corrected, and debris is not accumulating on the site. These inspections will be noted in the FLT logbook. Health and safety professionals present at the task site may, at any time, recommend changes in work habits to the FTL. However, all changes that may affect the project written work control documents (HASPs, RWPs, and SWPs), must have concurrence from the appropriate project technical discipline representative on site and a Data Analysis Report (DAR) prepared, as required.

Personnel working at the task site are responsible to use safe-work techniques, report unsafe working conditions, and exercise good personal hygiene and housekeeping habits throughout the course of their job.

9. PERSONAL PROTECTIVE EQUIPMENT

If field activities associated with the project tasks pose a hazard to project personnel, some measure of protection will be employed to protect the workers from the potential hazards. The purpose of PPE is to shield or isolate personnel from chemical, radiological, physical, or biological hazards that cannot be eliminated through engineering or other controls. It is important to realize that no PPE ensemble can protect against all hazards under all conditions and that work practices and adequate training will also provide a greater level of protection to workers. **Site-specific information regarding the requirements for PPE can be found in Appendix C (Explosive compounds), Appendix D (OMRE), and Appendix E (Wild Onions)**

Selection of the proper PPE to protect personnel is based on:

- Project tasks to be conducted (mobilization, etc.)
- Known or suspected radiological and nonradiological materials and agents present at the task site
- Potential contaminant routes of entry
- Physical form and chemical characteristics of contaminants
- Acute and chronic effects from exposure to contaminants
- Local and systemic toxicity of contaminants
- Anticipated exposure levels (surface and airborne).

Anticontamination (anti-C) requirements are dictated by RWP in conformance with LMITCO *Radiation Protection Manual*, MCP-432, "Personal Protective Equipment."

The PPE is generally divided into two broad categories: (1) respiratory protective equipment and (2) personal protective clothing. Both of these categories are incorporated into the standard four levels of protection (Levels A, B, C, and D), based on the potential severity of the project hazards. Table 9-1 provides guidance in the selection process for respiratory and protective clothing. Site-specific hazards and contaminants will be evaluated in determining the most appropriate PPE level and modifications.

9.1 Respiratory Protection

Radiological and nonradiological contaminants can present a significant potential respiratory hazard if released in an airborne respirable form. The level of respiratory protection is based on the tasks to be completed, amount and form of hazardous constituents, engineering controls that will be implemented, and containerized nature of core retrieved material (Table 9-1). **Site-specific information regarding the requirements for respiratory protection can be found in Appendix C (Explosive compounds), Appendix D (OMRE), and Appendix E (Wild Onions).**

Table 9-1. Respiratory and protective clothing selection.

Respiratory PPE Selection ^a	
Hazard	Level of Protection
Not immediately dangerous to life or health (IDLH) or oxygen deficient atmospheric conditions. Gaseous, vapor, particulate, and/or aerosol chemicals/radionuclides.	Level C—full-facepiece Level B—full-facepiece supplied air respirator with an air-purifying escape cartridge or airhood (bubblehood) HEPA/chemical combination cartridge for concentrations up to the protection factor of an air-purifying full-facepiece respirator and within the assigned derived air concentration (DAC) ^a value
IDLH or oxygen deficient atmospheric conditions. Gaseous, vapor, particulate and/or aerosol chemicals/radionuclides.	Level B—full-facepiece, supplied air respirator with an escape-only SCBA ^b or Level A—self contained breathing apparatus HEPA/chemical combination cartridge for concentrations up to the protection factor of an air-purifying full-facepiece respirator and within the assigned DAC ^a value

a. A multichemical/HEPA combination cartridge to be selected by IH and RADCON personnel based on specific task hazards.

Protective Clothing Selection	
Low atmospheric contaminant levels that are present under stable conditions. No anticipated immersion, splashes or potential for unexpected contact with chemical or radiological contaminants.	Level D
Moderate atmospheric contaminants under relatively stable conditions, liquid splashes or other direct contact that do not have corrosive characteristics or can be absorbed by exposed skin. Low radiological contamination and airborne radioactivity levels. ^c	Level C
Moderate to high atmospheric contaminants under unstable conditions, potential for contact with wet, contaminated surfaces/material that can saturate or permeate Level C protective clothing. Moderate radiological contamination and airborne radioactivity levels. ^c	Level B
High and unknown atmospheric contaminants, potential for contact with substances that pose a high hazard potential to the skin, high potential for splash, immersion or exposure to unexpected vapors, gases, aerosols, or dusts that present an IDLH situation/readily absorbed through the skin. High radiological contamination and airborne radioactivity levels. ^c	Level A

a. Derived air concentration (DAC) based on specific radionuclides.

b. SCBA = self-contained breathing apparatus.

c. Contamination levels and airborne radioactivity as defined by 10 CFR 835.603.d.

The safety analysis reports (SARs) and airhoods will be operated in a continuous flow mode so any leakage due to a momentary break in any seal or sealing surface is outward. Airlines will be kept as short as possible with a maximum length as stated in the manufacturer's operating instructions. **In no case will airline hoses exceed 91 m (300 ft).** Air for the SARs will be supplied from an onsite breathing air compressor with airline coupling station. The number of stations will be limited to the capacity of the compressor system to maintain the recommended airflow to each facepiece or airhood. At least 6 cubic feet per minute (CFM) will be supplied to all airline facepieces or hoods. Airline couplings will be Schraeder quick-disconnect (or equivalent, as long as they are integrated throughout the airline system and incompatible with other gas system couplings).

The compressor supplying the air shall be equipped with the necessary safety and standby devices. The compressor shall be constructed and situated at the site to avoid entry of contaminants into the air system and suitable airline air-purifying sorbent beds and filters installed to further ensure that delivered breathing air quality meets the requirements for Grade "D" breathing air (Compressed Gas Association Commodity Specification G-7.1-1996 and ANSI Z86.1-1993). A receiver of sufficient capacity to enable the respirator wearers to escape in the event of compressor failure (if escape bottles are not worn), and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor shall be frequently tested by the project IH for carbon monoxide and other Grade "D" air criteria, as required.

All personnel required to wear respirators shall complete training and be fit-tested before being assigned a respirator per the training and documentation requirements. Requirements for respirator use, emergency use, storage, cleaning, and maintenance, as stated in the *LMITCO Safety and Health Manual*, MCP-2726, "Respiratory Protection," shall be followed.

9.2 Personal Protective Equipment Levels

The level of PPE required for field work will be determined the HSO/IH and RCT, as necessary. Modifications to PPE levels shall be made under the direction of the HSO/IH and RADCON personnel, as appropriate. Such modifications are routinely employed during HAZWOPER site activities to maximize efficiency and to meet site-specific needs without compromising personnel safety and health. As needed, special attention will be given to both respiratory and protective clothing modifications to meet specific task requirements. **Site-specific information regarding the requirements for PPE levels are listed in Appendix C (Explosive compounds), Appendix D (OMRE), and Appendix E (Wild Onions).**

9.2.1 Level D Personal Protective Equipment

Level D PPE will only be selected as a work uniform and not on a site with respiratory or skin absorption hazards requiring whole body protection. It provides no protection against airborne chemical hazards, but rather is used for protection against nuisance contamination and physical hazards. Level D PPE will only be allowed in areas that have been characterized or are known to have never been contaminated [i.e., the Cold Test Pit (CTP)]. Level D PPE is allowed during mobilization tasks, tasks where it has been determined action levels (ALs) will not be exceeded. Level D PPE ensemble may be modified by the IH and/or RCT to provide protection from skin and physical hazards, but not respiratory protection. Basic Level D PPE consists of the following:

- Coveralls or work clothes (as determined by the IH, RCT)
- Hard hat (as required by SE and type of work being performed)

- Eye protection, safety glasses with side shields as a minimum (see LMITCO *Safety and Health Manual*, MCP-2716, “Personal Protective Equipment”)
- Safety footwear (steel or protective toe and shank, as determined by the SE).

Optional Level D Modifications consists of the following:

- Chemical or radiological protective clothing (Tyvek, Saranex, etc.) as prescribed in task-specific RWP or SWP
- Chemically resistant hand and foot protection (inner/outer gloves, boot liners, etc.)
- Radiological modesty garments under outer protective clothing
- Any specialized protective equipment (hearing protection, cryogenic gloves, face shields, welding goggles, aprons, etc.).

9.2.2 Level C Personal Protective Equipment

Level C PPE shall be worn when the task site chemical and/or radiological contaminants have been well-characterized indicating that personnel are protected from airborne exposures by wearing air-purifying respirators (APRs) with the appropriate cartridges, no oxygen-deficient environments exist (<19.5% at sea level), and that there are no conditions that pose immediate danger to life or health (IDLH). Basic Level C PPE shall include:

Level D ensemble with the following respiratory and whole body protection upgrades:

- Full-facepiece APR equipped with a NIOSH approved HEPA/chemical combination cartridge (IH to specify chemical combination cartridge)
- Chemical-resistant coveralls (Tyvek QC[®], Tychem 7500[®], Saranex-23-P[™], etc.) as prescribed in task-specific RWP or SWP (IH to specify material)
- Chemical-resistant outer shoe/boot cover (IH or RCT to specify material)
- Inner chemical-resistant nitrile rubber gloves with cotton liners (as determined by the IH and/or RCT)
- Outer chemical-resistant Viton or polyvinyl alcohol (PVA) gloves (as determined by the IH).

Optional Level C Modifications:[©]

- Radiological modesty garments under outer protective clothing
- Any specialized protective equipment (hearing protection, welding lens, aprons, etc.).

9.2.3 Level B Personal Protective Equipment

Level B PPE shall be worn when personnel cannot be adequately protected with APRs because there are high levels of contaminants present, the appropriate respirator cartridges or combination is not available, a significant hazard exists for skin exposure, or IDLH/oxygen-deficient conditions exist. If

IDLH conditions do not exist, then an escape air-purifying cartridge may be substituted for the escape bottle. Level B PPE includes:

Level C ensemble with the following respiratory and whole body protection upgrades:

- An airhood operating at a minimum pressure of 6 CFM or a full-facepiece SAR with a 10-minute escape bottle, an SCBA or an escape air-purifying combination HEPA/chemical cartridge [SAR hose length no more manufacturer's specification and **under no circumstances greater than 91 m (300 ft)**]
- Chemical-resistant coveralls or encapsulating suit (Tyvek QC[®], Tychem 7500[®], Saranex 23-C[™] or equivalent)
- Any other chemical or radiological PPE prescribed in task-specific RWP or SWP
- Chemical-resistant butyl or one-time-use natural latex outer boots (as determined by the IH and/or RCT)
- Inner chemical-resistant nitrile rubber gloves with cotton liners (as determined by the IH and/or RCT)
- Outer chemical-resistant Viton or PVA gloves (as determined by the IH).

Optional Level B Modifications includes:

- Radiological modesty garments under outer protective clothing
- Any specialized protective equipment (hearing protection, welding lens, aprons, etc.).

NOTE: *All seams must be taped and secured to prevent skin contact from hazardous substances in a soil, liquid, mist, and aerosolized form.*

9.2.4 Level A Personal Protective Equipment

The use of Level A PPE ensemble (fully encapsulating suits) is not anticipated for the project. Level A ensemble must be further evaluated to determine if the safety basis for activities are still valid or if additional safety analysis documentation is required. Before the selecting Level A PPE, the assigned IH and/or RCT must ensure that site characterization to identified known and potential chemical and radiological hazards is completed (to the extent possible).

Level A PPE has the maximum respiratory, skin, and eye protection, and is suitable for use in situations where the levels of contaminants are known to be very high and dangerous, levels are completely unknown, or an IDLH condition could develop. Level A PPE includes:

Level B ensemble with the following respiratory and whole body protection upgrades:

- Open circuit SCBA or a full-facepiece SAR with a 15-minute escape-only SCBA bottle operated in a continuous-flow mode [SAR hose length of less than 91 m (300 ft)]
- Fully encapsulating, chemical-resistant suit (Barricade[®], Tychem 10000[™], or equivalent)

- Chemical-resistant butyl or one-time-use natural latex outer boots (as determined by the IH and/or RCT)
- Inner chemical-resistant rubber gloves with cotton liners (as determined by the IH and/or RCT)
- Outer chemical-resistant Viton or PVA gloves (as determined by the IH).
- Radiological modesty garments under outer protective clothing
- Any specialized protective equipment (hearing protection, welding lens, aprons, etc.).

9.3 Protective Clothing Upgrading and Downgrading

The project HSO/IH and RADCON personnel will be responsible for determining when to upgrade or downgrade PPE requirements. Upgrading or downgrading of PPE requirements based on current conditions is a normal occurrence. Additional reasons for upgrading or downgrading include:

- Upgrading Criteria (work will stop immediately if PPE upgrading is required)
 - Unstable or unpredictable site radiological and/or nonradiological hazards
 - Contaminants that present difficulty in monitoring or detecting
 - Known or suspected presence of skin absorption hazards
 - Temporary loss or failure of any engineering controls
 - Identified source or potential source of respiratory hazard(s)
 - Change in the task procedure that may result in an increased contact with contaminants or meeting any of the criteria listed above.
- Downgrading Criteria
 - Monitoring data that show the contaminant levels to be lower than established action limits
 - New engineering or administrative controls that eliminate or significantly mitigate hazards
 - Elimination of potential skin absorption or contact hazards
 - Change in conditions that results in a hazard being reduced or isolated to a controlled area
 - Completion or change in tasks that results in the elimination of key hazards that require higher levels of PPE.

9.4 Inspection of PPE

All PPE ensemble components must be inspected before use and when in use within project work zones. Self-inspection and the use of the buddy system, once PPE is donned, will serve as the principle forms of inspection. If at any time PPE should become damaged or degradation/permeation is suspected, an individual will inform others of the problem and proceed directly to the work zone exit point to doff and replace the unserviceable equipment. Additionally, all PPE that becomes grossly contaminated or presents a potential source for the spread of such contamination, will be required to be decontaminated or replaced. Table 9-2 provides an inspection checklist for common PPE items.

Table 9-2. PPE inspection checklist.

PPE Item	Inspection
Gloves	<p>Before use:</p> <p>Pressurize gloves to check for pinholes, “twirl” the glove, then roll until air is trapped and inspect. No air should escape.</p>
Respirators (full-facepiece air-purifying and supplied air respirators with escape-only SCBA bottles or escape cartridges)	<p>Before use:</p> <p>Airline matches the airline respirator to be used (black hose)</p> <p>Inspect airline hose connections (sections of hose) to ensure all are threaded or permanent metal-to-metal connections (no quick disconnect pieces)</p> <p>Check condition of the facepiece, head straps, valves, connecting lines, fittings, all connections for tightness</p> <p>Check cartridge to ensure proper type/combination for atmospheric hazards to be encountered, inspect threads and O-rings for pliability, deterioration, and distortion</p> <p>Check for proper setting and operation of regulators and valves, check all hose connections back to the breathing air compressor, check the pressure to the airline station, and on individual airline connections to ensure pressure is within required range (in accordance with the manufacturer’s specification).</p> <p>Before entry into Level B area</p> <p>Ensure air compressor is providing a minimum of 110 psi when all personnel have airlines hooked up to compressor manifold.</p>
Airhoods	<p>Before use:</p> <p>Airline matches the airhood to be used (red hose)</p> <p>Airhood is within 3 year shelf-life (for PVC components)</p> <p>Visually inspect all seams and surfaces for tears, cracks, etc.</p> <p>Pressurize airhood to check for pinholes or defective seams (no air should leak out when choking clear hood piece).</p> <p>Before entry into CA:</p> <p>Inspect all airline connections for tight fit (pull connections three times).</p> <p>Ensure air compressor is providing a minimum of 110 psi when all personnel have airlines hooked up to compressor manifold.</p>

Table 9-2. (continued).

PPE Item	Inspection
Level D, C, and B clothing	<p>Before use:</p> <p>Visually inspect for imperfect seams, nonuniform coatings, tears, etc. Hold PPE up to the light and inspect for pinholes, deterioration, stiffness, and cracks.</p> <p>While wearing in the work zone:</p> <p>Evidence of chemical attack, such as discoloration, swelling, softening and material degradation. Inspect for tears, punctures, and zipper or seam damage. Check all taped areas to ensure they are still intact.</p>
Level A encapsulating suit	<p>Before use:</p> <p>Same item as with other protective clothing, with the addition of checking the operation of the pressure relief valve, inspect fitting of wrists, ankles and neck. Inspect face shield for cracks, fogginess, scratches, and crazing.</p> <p>While wearing in the work zone:</p> <p>Same as other protective clothing.</p>